

# INFORMATICS

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**informatics** (in-fər-ma-'tiks) n.

The science of the systematic and effective treatment, especially by automatic machines, of information seen as the support for human knowledge and for communication in technical, economic and social spheres.  
[f. F *informatique*, n.]



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**Note**  
The learning resources for this document  
have been published in a separate  
document.

# Introduction

The last decade has been one of evolution in secondary school education related to the computer and to information processing. Teachers have faced an ever-changing technology and this, together with the opportunity to develop their own courses in an environment receptive to ideas and experimentation, has resulted in extensive revision of courses in the search for more precise objectives and improved approaches. The time from the introduction of *Curriculum RP-33, Data Processing*, 1966 to the present has been a period of improvement both in content and in technique of presenting it. Today's courses reflect the opinions of teachers who have become experienced, knowledgeable, and mature in their field, and this guideline is intended to capture their views.

As well as providing for basic general courses, studies based on *Informatics* can provide an excellent foundation for specialization in computer education. Three distinct avenues of further study are supported by Ministry of Education guidelines:

- *Computer Programming and Systems Analysis* (RP-33, 1966)
- *Computer Science*, 1970
- *Elements of Computer Technology*, 1970

*Informatics* allows the student to discover his interest and aptitude for continuing study in this field. A course based on this guideline should not, however, be regarded as a prerequisite, since each of the above programs offers the student unique and interesting opportunities.

Those who contributed to this guideline favour its development as a one-year introductory course at the intermediate level. It is then possible to offer additional one- or two-year programs in each of the three specialized areas. Schools are free, however, to follow other plans of their own choosing.

This guideline replaces "Principles of Data Processing, Grade 10" in R.P. 33, pages 1 to 4, 1966.



# Rationale

In all walks of life today man is confronted by a new order of information processing that has become a common element of society. New sophisticated techniques have been bestowed on us with profound impact by a persistently progressive technology.

It is not surprising that people tend to be overwhelmed by the seeming complexities of modern information processing. For this reason, it is important that a course in this challenging and contemporary subject be made available in our secondary schools so that our young people are prepared for entry as responsible and informed citizens into a complex adult society.

*Informatics* will provide the student with insight and perspective in this new field of study. As well, it will help to dispel the mystique of the computer, to point out career opportunities, to show relationships to other subject areas, and to prepare the way for possible further specialized study.

## The Data Centre

Throughout the sixties, a data processing gap has opened for the small and medium sized manufacturer. These businesses are the backbone of any area's economy. Unable to finance complex "in-house" information systems and facing the same "need to know-now" requirements as the largest conglomerate, the men, who are these companies, have turned profitably to the data centre.

Honeywell Information Systems

## Communications

We have reached a point at which the extra information carrying capacity of the public telephone network will soon allow us to add extra facilities to the telephone to make it much more useful. The obvious thing to do is to add vision, and a Picturephone service has already begun operating in the United States.

Ron Brown in *New Scientist*

## Invasion of Privacy

"The addition of remotely located terminal devices significantly increases the potential problems and the resulting concern for data security. Problems range from preventing the curious intruder from browsing through personnel rosters, customer lists, operating statements, etc., to preventing the malicious intruder from altering payroll records, obtaining secret financial data or illegally obtaining copies of new product specifications."

International Business Machines Co. Ltd.

## Industrial Control Systems

The mechanical system of one of the most modern grain elevators—capable of handling more than 35 million bushels of grain annually—has been placed under the control of two solid state programmable controllers each about the size of a large breadbox.

Digital Equipment of Canada Ltd.

## Dehumanizing of the Individual

In this computerized age, the law must require that men in the use of computerized data regard those with whom they are dealing as more important than a perforation on a card.

Milton R. Wessel in *Business Automation*  
November 1970

## Space Exploration

Space flight means speed. When a man is orbiting at 18,000 miles an hour, we can't spend a week making the calculations necessary to find out where he is at any given moment, or whether or not the automatic systems that keep him alive are creeping out of adjustment. Computer systems that operate in what scientists call "real time" are doing these jobs for us.

Univac Co. Ltd.

## Medicine

Medical doctors of the future will have on call computerbased information banks enabling them to compare their patients' symptoms with those of millions of cases by merely dialing up the information centre and "feeding in" their patients' symptoms. The most probable diagnosis and treatment would be instantly available.

O.I.S.E. Department of Computer Applications

### Voting

With automated data processing doing almost all of the work at the polls, calculation time is decreased, the cost factor reduced, and the number of necessary polling personnel minimized.

### Honeywell Information Systems

### Growth of the Computer Industry

The computer industry has come to a major crossroads in its short but dramatic history. Its continuance as the world's fastest growing major industry is not in doubt; neither is its inexorable progress toward becoming the world's largest business, surpassing in gross revenues the automobile and petroleum industries before the turn of the century.

Globe and Mail, June 2/70

(William D. Smith, New York Times Service)

### Simulation

A company may test the design of a new processing plant by simulating every detail of its operation with a computer. Computer simulation frequently provides more information in a week than an expensive pilot plant could in a year of actual operation.

Univac Co. Ltd.

### Research

Scientists can now perform computations that would not have been possible without a computer. For example, it is not uncommon to find scientists doing in hours—with a computer—what it would have taken hundreds of years to accomplish without a computer. This puts the scientist right in the middle of the future—now.

American Federation of Information Processing Societies

### Municipal Administration

Metro Chairman Albert Campbell hopes to have 'one big brain' for all of Metro in a few years—a gigantic computer that will contain property information, police information, tax rolls, administrative information and other files for Toronto and the five boroughs.

Globe and Mail, July 9, 1971

### Business

The kind of information that can be made readily available through the use of computers is almost limitless. Analysis of sales and profit data by product, salesman, territory, promotion expenditures, etc.; production expenses by product, cost centre, labour category, location; inventory levels and requirements by product, and many other variables can be easily performed.

A. I. Boykiw

In The Canadian Chartered Accountant  
March/68

### Social Impact

Probably no other invention in man's history has more potential to break the chains of drudgery than the computer. And likewise, no other creation of man brings such power to enhance his intellect and creativity. Because, in actuality, that is what the computer is—an extension of man's intelligence.

C. C. Hurd

Chairman of the Board

Computer Usage Company Inc.

### Traffic

The computer is helping to relieve the nation's auto traffic problem. On one freeway, gaps in traffic during peak periods are detected by sensing devices. This information is relayed to the computer. When gaps in the traffic arrive, access road lights are turned green by the computer, so that motorists can enter the freeway. The system has cut rush-hour accidents in half, while the average speed of autos has increased 30 per cent.

International Business Machines Co. Ltd.

### Airline Reservations

An airline reservations clerk, for example, can press a few buttons to request a reservation on a certain flight for a certain day. In seconds, a central computer thousands of miles away can check reservations for that flight made by all the airline's ticket offices around the country, establish the availability of the space requested, and flash back an answer. The reservations clerk then keys in the information needed to make the reservation and the central computer updates its records instantly.

Univac Co. Ltd.

### Crime Control

The policeman cruising the city notices a man behaving oddly as he gets into his car. Is it his car or is it stolen? The officer radios headquarters giving the licence number, and an operator keys in the number, immediately obtaining the information that, indeed, that licence number is on the list of stolen vehicles. The policeman takes action. The computer has entered into the field of crime detection.

E. Squire

The Computer — An Everyday  
Machine



# Objectives

- to help the student develop logic, initiative, and creativity through individual and group experiences in problem-solving;
- to help the student become aware of the computer's capabilities and limitations through a study of its functions;
- to encourage the student to evaluate the significance of information processing devices as a new dimension in his own life and in society;
- to provide a learning environment in which the student can appreciate the technological achievement of man in the development and use of the computer;
- to allow the student to discover his aptitude for further study in the computer field.



# Developing a Local Course

In building a local course from *Informatics*, the teacher may make a selection from nine basic units of study suggested in the guideline. These nine units contain a considerably larger number of topics and suggestions for study than would ordinarily be covered in one year. Thus the teacher has a fund of material from which to choose the topics most appropriate to his course.

In developing a course, the teacher must weigh several factors. Naturally he will be strongly influenced by his own strengths and interests, but he should also be mindful of the interests and preferences of his students. He should provide enough flexibility in his course to take advantage of timely incidents, technological developments, or new advances in information processing techniques.

Each unit of the guideline is divided into two sections, *General Study Topics* and *Additional Study Topics*. Topics that provide comprehensive and fundamental knowledge in the subject are detailed under the heading *General Study Topics*. The heading *Additional Study Topics* provides supplementary topics and statements that lend themselves to investigation in depth and that promote discussion or research. The teacher, and his students are free to study any number of the units of instruction. Some may choose to study only a few; others may prefer to touch on them all or to select a middle course. The fact that certain specific topics are relevant to more than one unit of instruction provides an extra element of flexibility in course development.

Access to equipment is desirable but not essential: the resourceful and imaginative teacher will find ways to compensate for lack of equipment. For example, the process of sorting punched cards can be effectively demonstrated by using small cardboard boxes for the pockets of the machine and by using students to provide the motive power. The action of the computer can also be simulated by having its various sections represented by students who perform manually the sequence of operations necessary to solve simple problems.

It is not expected that the units of study be presented in any special order. For this reason, they are presented alphabetically, permitting the teacher to organize the topics according to his preferences. He will likely find it helpful, however, to exchange ideas with an experienced teacher, particularly if he is a beginner.

Experienced teachers of this subject hold certain views in common. One commonly held view is that students are better motivated and more aware of the significance of different aspects of the course if they learn enough of a programming language to permit them to use a computer to solve some simple problems early in the year. Another is that an overview of the *Applications of Information Processing* unit of study early in the year encourages students to collect information from newspapers, magazines, and other publications. The topic could be covered more extensively later in the year. It has been found that it is best to introduce historical topics throughout the year when they are relevant or when a change of pace is needed, rather than to study the history of data processing as a complete unit.

The course lends itself to a variety of pedagogical techniques, among which are: field trips (perhaps a visit to a computer installation), individual and group projects, case studies, simulations, games, and films. It should be a regular part of the learning process to go beyond the classroom environment, to take advantage of community resources, and to find materials and information in books, magazines, and newspapers. Because the relationship of the course to life in the community and to society in general is of paramount importance, strict adherence to a particular text is not advisable. The ideal classroom will have a number of good reference books, journals, films, and other materials.

Although there is bound to be a variety of emphases and approaches to the presentation of this subject, the influence of information processing on society and on the students' own lives is of such importance that it should be a pervading theme in the entire course. Students should be encouraged to look objectively at the various aspects of information processing and to weigh, without prejudice, the merits of each in the light of the needs of society, to consider alternative possibilities, and to assess the validity of societal goals. Students should be encouraged to express their opinions freely and not to skirt controversial issues.

It is hoped that through the course the student will gain an understanding of the ceaseless nature of technological progress and will appreciate the necessity of being able to cope with change. Both teachers and students should appreciate the need for continually bringing their own education up to date.

Applications of Information Processing

The utilization of information processing equipment and techniques in the modern world has been truly impressive. Many ingenious people have put their minds to the task of realizing the labour-saving and problem-solving capabilities of the computer. A great deal has been done and more can be expected. With increasing numbers of people gaining competence in this field, additional advances in technology, reductions in costs, and diminishing public resistance, even greater accomplishments will be realized in the future.

Certainly, the ultimate potential of the computer has not yet been achieved: it is limited only by the intelligence of men and the resources of mankind.

General Study Topics

The following applications involve routine computer operations:

**Accounting (financial and other)**  
Payroll, student records, inventory control, airline reservations, placement of railway cars, banking

**Statistical**  
Sales analysis, sports records (Olympic games), election results, census, educational records

The following computer applications are more sophisticated:

**Monitoring and process control**  
Medical applications, computer-assisted instruction (C.A.I.), quality control, production scheduling, traffic control

**Scientific**  
Structural design, medical research, space exploration, numerical analysis

**Simulation**  
Didactic gaming, space exploration, flight, city planning

**Forecasting**  
Environmental planning, economic and social planning, weather

**Information retrieval**  
Management information, legal information, microfilming, libraries, computer-managed instruction (C.M.I.)

Additional Study Topics

The following topics might supplement the general ones already outlined:

**Accountancy**  
Implications for the profession

**Archaeology**  
Use of computers for successful digs

**Art and music**  
The computer as a creative artist or a purveyor of culture

**Automotive industry**  
assembly-line scheduling

**Banking**  
The cashless society, customer records

**Business**  
The influence of universal credit-card operations on consumer spending

**Computer use in education**  
Courses in computers at elementary, secondary, college, and university levels; use of the computer for control of finances, scheduling of classes, recording of attendance records, and scoring of tests

**Computer utilities**  
The new giants of industry

**Government**  
Massive information management, controlling the economy

**Insurance**  
One of the first big users

**Legal uses**  
Case search

**Libraries**  
Listing of bibliographies, information retrieval, book control

**Marketing**  
Programming of models of the marketplace for sales forecasting

**Medicine**  
Diagnosis at the touch of a button

**Military**  
Missile control, defence networks, war simulation

**Research**  
Research simulation to predict possible outcome of experiments

**Scheduling**  
Traffic control, transportation industries, manufacturing, service industries

**Science**  
Space research, structural design, space photography, space vehicle direction



# Communications

The history of communications is linked to the history of civilization. Advances in communications have always influenced the course of mankind because society's attitudes and man's habits are strongly affected by whatever communication techniques are available.

At no time in our history has the effect of communication been more evident than in recent years. The rate of change in communications and other technologies has been extremely fast. Society has responded to this communications revolution with a cultural shift of its own, creating an environment in which conventional patterns of behaviour are affected by worldwide news and events.

## General Study Topics

- Man-to-man communication might be considered under the following headings:

**Man's ability to use all his senses to communicate**

**Man's use of verbal codes to communicate**

Listening, speaking, reading, writing

**Man's use of non-verbal codes to communicate**

Symbols, gestures, posture, facial expression, movement of hands and body

**Man's development of language to facilitate communication**

**Man's development of aids to communications**

Newspapers, books, radio, television, telephone, telegraph

- Man-to-machine communication might be examined under the following headings:

**Man's development of special languages to communicate with computers**

Machine level, low level, high level

**Programming of simple problems**

- Machine-to-machine communication might include the following topics:

**Need for machine-to-machine communication**

**Teleprocessing**

Computer to terminal, computer to computer

## Additional Study Topics

The following topics will enrich the study of communication:

- The advantages and disadvantages of man's various means of communication

- Sociological impact of the telephone, telegraph, radio, television

- Technical study of the telephone, the radio

- The impact on society of man-to-man communication, man-to-machine communication, machine-to-machine communication

- Problems created by lack of communication

- The need for bilingual computers in Canada

- "Senses" available for communication to man but not to the computer

- Communicating with the computer by voice

- The need for language translators and how they are prepared.

- A low-level language (facilitates understanding of how a computer performs its tasks)

- Introduction to a high-level language

- Telecommunications control language (not a language itself but the "hand-shaking" only such as input/output code, query code, response code, parity check code)

- Synchronization of communications lines

- Necessity of teleprocessing network for Canada

- Communications satellites

- Communications monopoly

# Evolution of Information Processing

What are the factors that bring about technological change in society? Certainly, the answer to this question is tied directly to the nature of man, which, because of his intelligence, inquisitiveness, inventiveness, ingenuity, and drive, has led him to search for and find new and more efficient ways of doing things.

For centuries man has had to contend with the problem of processing information. It is not surprising, therefore, that this has been an important area of technological development. It has proved to be fruitful ground upon which to exercise man's talent and imagination.

## General Study Topics

Students might consider the development of:

### Computers

Babbage, stored programs

### Printing methods

Symbolic representation, written language, paper, printing press, typewriter, modern methods

### Communications

Audio, oral, and visual signals; transportation, telegraph; telephone; electronic communications

### Calculators

Fingers; abacus; Napier's bones; gear calculator (Pascal); mechanical, electro-mechanical, electronic methods

### Data storage

Ancient methods, paper, books, libraries, filing cabinet, punched card, paper tape, film, microfilm, microfiche, magnetic and electronic films

## Additional Study Topics

The following topics might enrich those outlined above:

- Language development
- People involved with the development of computers (Von Neuman, for example)
- Implications of the adage *Necessity is the mother of invention*
- Legal, social, cultural, and economic implications of photocopying
- Social problems caused by mass media
- Social benefits of mass media
- Effect of calculator availability on computation skills
- Implications of the saying *Solutions create problems*
- Paper pollution
- Obsolescence, a product of technology



## Impact of Information Processing Technology on Society

For most of human history, it has been typical for a man to spend his entire life within fifty miles of his birthplace, performing tasks appropriate to the locality. Basic values and behaviour patterns were stable and predictable.

The knowledge explosion and the technological revolution have altered this pattern, as values, beliefs, and ways of living are constantly challenged. Continual adjustment, a result of the search for viable and relevant objectives in the face of persistent change, is the new order of life.

### General Study Topics

Central to this theme is consideration of the impact of information processing on:

#### The individual

Privacy and personal rights (telephone, data banks), employment, new careers, job opportunities, retraining, business transactions (automated billing, credit cards, consumer spending)

#### The community

Urban planning, traffic control, law enforcement, job displacement caused by technology

#### The nation

Defence, economics, legalities, communications media, statistics

#### The global society

World government; international standards; communications media; exploration of space, sea, and land; reporting of current events

### Additional Study Topics

The following topics will supplement the basic ones listed above:

- Subliminal perception
- Computer empire-building
- The computer as the scapegoat for human errors
- The computer in medicine
- Justification of computer applications
- Frustration of dealing with a computer-oriented system
- Video conference calls as replacement for business meetings
- Computer-assisted instruction
- The computer as an intelligence machine
- Cybernetics
- Computers in the home
- The computer as a substitute for the school
- Non-acceptance of the computer
- The effect of the computer on familiar patterns of life
- News dissemination

# Information Processing Devices

The coming of the ordinary punch card opened the door to modern information processing techniques. At that time, it was impossible to foresee what has proved to be a field of technology of immense proportions.

Business and industry, in attempting to profit from it, were quick to pursue and build on the new technology. Their efforts resulted in the appearance on the market of a variety of new devices, services, and products, many of which have demonstrated their lasting value. As the trend continues, one cannot help speculating about future developments.

## General Study Topics

The following topics are considered central to the over-all theme:

### Recording

Card punches, tape punches, magnetic encoders for mark-sensing (optical and electromagnetic), typewriter, magnetic ink encoders, automatic image generation

### Duplicating

Photocopiers, duplicators, reproducing punches

### Manipulating

Card sorter, collator, computer

### Calculating

Calculators, computers

### Transmitting

Telephone, telegraph, radio, television, satellites, terminals, facsimile, microwave

### Displaying

Printers; analog computer output devices; medical, scientific, and industrial display devices.

## Additional Study Topics

- An in-depth study of the characteristics and operating principles of information processing devices
- The computer as an all-encompassing information processing device
- Information processing devices as extensions of man's capabilities to process information
- The potential of the laser as an information processing medium

## Organization of a Digital Computer

From the airplane and the automobile to the television set and jet propulsion, each generation of this century has witnessed an increasing number of inventions, each the product of its own time. The newcomer in recent years has been the computer, its roots already sunk deeply into the fabric of society. Although relatively new, the computer has itself undergone several *generations*, each incorporating dramatic changes in technology.

The computer is evidence of the amazing ingenuity of man. On the surface, a computer configuration may not appear to be complex; beneath the tranquillity of its exterior lies a network of electronic circuitry and mechanical gadgetry that appears incomprehensible to the layman.

### General Study Topics

The following topics are intended to give students a basic knowledge of this unit:

#### Input devices

card reader, paper tape reader, optical scanners (OCR) and readers, magnetic scanners (MICR), keyboard

#### Central processing unit

Storage, arithmetic, logic, control

#### Output devices

Printer, paper tape punch, card punch, audio response unit, cathode ray tube devices, plotters

#### Auxiliary storage

(these devices can be used for both input and output)

Magnetic tape, magnetic disk, data cell

#### Data communications devices

General purpose terminals (typewriter, visual display), special purpose terminals (banking), remote job entry, communications facilities (common carriers)

### Additional Study Topics

The following topics may enrich a student's understanding of those listed under *General Study Topics*:

- Technology and operating principles of digital computer devices
- Scientific and business applications of digital computer devices
- Choice of device to be used — disk or tape, or non-computer alternatives
- Digital computer devices as extensions of man's capabilities
- Trends in computer technology
- Evolution of computers

# Organization of an Information Processing Centre

The importance of the computer's role in business, science, and government is increasing. The availability of smaller and cheaper computers, improved price/performance ratio, and improved data in transmission technology have been factors contributing to increased use.

Once accepted into an organization, the computer becomes a key component of the system. Its vital role demands that the entire computer resource be subjected to thorough study and organization, combining well planned facilities with a proper blending of managerial, technical, and other talent.

## General Study Topics

The organization of an information processing centre might be studied through a discussion of:

### Personnel

The functions of a planning group, a development group, an implementation group, an operations group

### Functional design

Physical layout, equipment, movement of data, movement of people, storage, space utilization

### Operating procedures

Need for documentation, standard operating procedures, scheduling, priority planning, controls

## Additional Study Topics

The above topics may be enriched by some of the following:

- Careers and opportunities in information processing
- Project to examine needs, justification, and alternatives in organization for such types of information processing centres as audio-visual, resource, computer, word processing, printing, traffic control, crime control
- Research of trends in organization of information processing centres
- Study controls needed in accounting, banking, libraries, space travel, traffic, medicine, schools
- Deterrents to change caused by complexity or rigidity of system, personnel attitudes



## Problem Solving

The complexity of modern society requires that people weigh alternatives, reach conclusions, make decisions — in short, that they *solve problems*. As more and more fields are conquered, one might expect the need to solve problems to become less prominent. The contrary, however, seems to be the case. Our complex society creates new problems, some of which, such as pollution, have serious and far-reaching consequences. The betterment of society depends on the ability of its members to balance the problem-solving scale in their own favour.

### General Study Topics

The following topics are considered central to this subject:

#### Problem recognition

Analysis, general statement, specific definition

#### Problem solving and implementation techniques

Algorithm, flowcharting, coding, testing, debugging, decision tables, tree diagrams, alternate solution, analysis of existing methods of problem solution, review and revision, parallel operations, sample data

#### Documentation

Reasons for documentation, report including identification, purpose, use, method, sample data, operating instructions, sample output, flowchart or equivalent

### Additional Study Topics

The preceding topics may be expanded by consideration of the following:

- Computer and non-computer working co-operatively
- The computer: servant or master?
- Computer perspective: cost vs performance

# Processing Data into Meaningful Form

Only a quarter of a century ago, information was commonly recorded by pen and ink or typewriter. For the most part, the use and manipulation of data were confined to the activities of business and government, primarily for financial and statistical purposes.

Since then, our horizons have expanded as computer professionals have showed us how to take advantage of the power and potential of the computer. Many segments of society that previously did not need to process data have suddenly become data conscious. Motivated by the greater availability and usefulness of information, they have become concerned with such matters as data storage and retrieval, data manipulation, computer speed, and computer output.

## General Study Topics

Students might consider the processing of data under the following headings:

### Nature of the data

Survey data, statistical data, analog data, digital data

### Storage

Paper, paper tape, punched card, magnetic tape, magnetic disk, magnetic drum, magnetic card, data cell, microfilm, internal computer storage

### Organization

Data item, logical record, physical record, file — sequential, file — random

### Representation

Number and coding systems (e.g., Hollerith, BCD, EBCDIC, ASCII)

### Processing techniques

Sorting, merging, matching, selecting, verifying, interpreting, reproducing, gang punching, editing, calculating, summarizing, tabulating

### Putting into meaningful form

Types of reports (printed, visual, audio), format — detailed or exception

## Additional Study Topics

- Data pollution — necessary vs unnecessary data
- Information amplification for operating management vs data reduction for top management
- Equipment and computer software used for processing data considered through study or actual experience
- Legal problems — invasion of privacy, security of information
- The relationship among coding systems, media, and application
- File design projects using familiar examples such as a student file or a library catalogue.



